Before Otago Regional Council

In the matter of	The Resource Management Act 1991
And	
In the matter of	An application for resource consent to discharge wastewater overflows from Queenstown Lakes District Council's wastewater network - RM19.051

STATEMENT OF EVIDENCE OF HELEN DIANE TROTTER FOR

Otago Fish & Game Council

Dated 29 October 2019

Qualifications and Experience

1 My name is Helen Diane Trotter.

2 I am currently employed as a Fish and Game Officer with the Otago Fish and Game Council. I have held this position for 7 years.

3 Over the past 10 years I have worked in the areas of freshwater ecology and fisheries management. Prior to my employment with Otago Fish and Game I worked as a fisheries technician over three seasons in Alaska, USA, undertaking a range of fisheries and environmental monitoring and research, including water quality sampling, in both the public and private sector.

4 I hold a Bachelor of Science in Biology and Environmental Science and a Postgraduate Diploma in Environmental Science, both from the University of Auckland. I am currently completing a Master of Science in Zoology (part-time) at the University of Otago, studying food-web interactions and algal blooms in Lake Hayes and Lake Johnson. This work has included sampling for nutrients and water clarity as well as phytoplankton, zooplankton and fish communities within the lakes.

5 In my role I routinely undertake fisheries monitoring and aquatic habitat assessments. In addition, my work involves management of recreational fishing. I have undertaken annual surveys of anglers within the upper Clutha/Kawarau catchment (and elsewhere across Otago) to investigate patterns of use, and assessment of angling experiences, including drivers of satisfaction.

Scope of Evidence

6 I have been asked by the Otago Fish and Game Council to prepare evidence on the following matters:

(a) Sports fish and recreational fishing values in the upper Clutha/Kawarau catchment;

(b) Potential effects of the wastewater discharge for sports fish and recreational angling values;

7 In preparing this evidence I have reviewed:

(a) The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:

(i) the Queenstown Lakes District Council consent application

(ii) Otago Regional s42A report

(iii) Expert evidence by Dr Dean Olsen

(iv) Expert evidence by Mr Neale Hudson

(v) Expert evidence by Dr Michael Greer

(b) Peer-reviewed scientific articles, published reports and policy documents as referenced.

Code of Conduct

8 I have read the Code of Conduct for Expert Witnesses in the Environment Court's Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed

Sports fish values

9 Highly significant sports fish values are found in a range of water bodies in the Queenstown Lakes District (QLD).

10 Brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) are widely distributed with self-sustaining populations found lakes, rivers and streams across the Upper Clutha/Kawarau catchment. Brown trout in Otago generally spawn in autumn and early winter, while rainbow trout spawning may occur from winter into early spring. Spawning occurs in tributaries of lakes and larger rivers.

11 Limited releases of rainbow trout occur only to waters without suitable spawning habitat and for youth fishing events (e.g. Lake Johnson, Lake Tewa)

12 Schedule 1A of the Regional Plan: Water for Otago (RPW) lists significant presence of trout as an ecosystem value for many waterbodies potentially affected by wastewater overflows including Lake Wakatipu, Lake Wanaka, Lake Hawea and Lake Hayes, Kawarau River, Clutha/Mata-Au, Hawea River, Arrow River, Cardrona River, Bullock Creek, Horne Creek (lower reaches).

13 Schedule 1A (RPW) also recognises the upper Clutha River, Cardrona River, Arrow River, Hawea River, Mill Creek, Bullock Creek, Horne Creek and the

Buckler Burn as significant trout spawning and rearing habitat. Fish and Game have also identified significant brown trout spawning in Luggate Creek[1].

14 Chinook salmon (*Onchorhynchus tschawytcha*) are found in the three large glacial lakes (Wakatipu, Wanaka and Hawea) and move along larger rivers including the Upper Clutha and Hawea River. These populations are predominately landlocked, with salmon completing their life cycle and spawning in the tributaries of the lakes. Apart from a few locations, such as Diamond Creek at the head of Lake Wakatipu, the distribution and timing of salmon spawning within the lakes is not well defined but is generally understood to occur from April-June. Research has confirmed that some salmon do move downstream and survive passage through the Clyde and Roxburgh dams, migrating to the ocean before eventually returning to the Clutha/Mata-Au and contributing to the lower Clutha/Mata-Au salmon run[2].

15 Schedule 1A (RPW) identifies significant presence of salmon as an ecosystem value for the upper Clutha/Mata-Au, Hawea River, Kawarau River, Lake Hawea, Lake Wakatipu and Lake Wanaka.

16 European perch (*Perca fluviatilis*) are present in Lake Hayes and thought to be primarily contained within Lakes Hayes (and nearby Lake Johnson). Perch spawn within in lakes in the spring.

17 Records of sport fish occurrence recorded on the New Zealand Freshwater Fisheries Database (NZFFD) for waterbodies named in the application are summarised in Table 1 of Dr Olsen's evidence. The presence of sport fish based on known or expected distribution where there are no NZFFD records is also identified.

18 The habitat and water quality requirements of salmonids (trout and salmon) are well described in the literature[3]. Adult salmonids require suitable temperatures, dissolved oxygen levels, water clarity/turbidity and macroinvertebrate food sources. For the spawning and incubation period temperature and dissolved oxygen as well as low fine sediment in the substrate are critical. Salmonids are also generally relatively sensitive to toxic substances and contaminants in the environment.

19 Suitable salmonid habitat is widespread in the upper Clutha/Kawarau catchment as water quality is generally very good. Lake Wakatipu and Lake Hawea are

[1] Otago Fish and Game Council unpublished data
[2] Otago Fish & Game Council (2015). Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p.
[3] Hay, J., Hayes, J. and Young, R. (2006) Water quality guidelines to maintain trout fishery values. Prepared for Horizons Regional Council. Cawthron Report No. 1205. 17 p.

classified as microtrophic and Lake Wanaka as oligotrophic[4], indicating very low levels of nutrients and good ecological condition. Similarly, rivers and streams monitored for Otago Regional Council (ORC) State of Environment reporting are mostly found have good water quality and generally meet water quality standards.[5]

20 Counts of faecal indicator bacteria (*Escherichia coli*) are generally low with few exceedances of contact recreational guidelines[6].

21 Lake Hayes and Mill Creek are notable exceptions with regard to water quality. Lakes Hayes is classified as eutrophic and is nutrient enriched as of result of historical land-use practices and ongoing inputs nutrients and sediment from the surrounding catchment[7]. Periodic algal blooms occur in the lake during summer, and high temperature, high pH and low dissolved oxygen can cause acute negative effects on aquatic life[8], including fish kills affecting trout[9]. In Mill Creek nitrate and *E. coli* levels exceed the targets set in Schedule 15 of the RPW.

22 Perch are more resilient than salmonids to warm temperatures[10], such as the conditions found in Lake Hayes and Lakes Johnson during the summer-autumn stratification period.

Recreational fishery values

23 The sports fish populations of the upper Clutha/Kawarau catchment support highly significant recreational fisheries. Its lakes, rivers and streams provide a range of settings and opportunities for anglers of all skill levels to utilise various fishing methods (spin, bait, fly, trolling), which together offers a diversity of angling experiences across the Recreational Opportunity Spectrum[11].

24 The lakes and large rivers (Kawarau and upper Clutha/Mata-Au) are open to fishing year-round (except for the Deans Bank section of the upper Clutha/Mata-Au, closes 31 May) although use is highest from December-March[12]. Other river

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[4] Land Air Water Aotearoa (LAWA) www.lawa.org.nz accessed 25 October 2019

[5] Uytendaal, A. and Ozanne R. (2018) State of the Environment Surface Water Quality in Otago 2006 to 2017. Otago Regional Council, Dunedin.

[6] Uytendaal, A. and Ozanne R. (2018) State of the Environment Surface Water Quality in Otago 2006 to 2017. Otago Regional Council, Dunedin; Ministry for the Environment & Ministry of Health (2002) Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment, Wellington. 89 p..

[7] Otago Regional Council (2009) Otago lakes' trophic status. Otago Regional Council, Dunedin. 141 p.

[8] Otago Regional Council (2009) Otago lakes' trophic status. Otago Regional Council, Dunedin. 141 p.

[9] Trotter, M. (2007) Lake Hayes water quality. Report to the agenda for the April 2007 meeting of the Otago Fish and Game Council.

[10] Collier KJ & Grainger NPJ (eds) 2015. New Zealand Invasive Fish Management Handbook. Lake Ecosystem Restoration New Zealand (LERNZ; The University of Waikato) and Department of Conservation, Hamilton, New Zealand. 212 p.

[11] Otago Fish & Game Council (2015). Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p.

[12] Unwin, M. (2016). Angler usage of New Zealand lake and river fisheries: results of the 2014/15 National Angling Survey. NIWA Client Report CHC2016-021 prepared for Fish & Game New Zealand.

fisheries are generally open from October/November - April/May when they close for the spawning period.

25 Annual fishing competitions are well established on the lakes. The Glenorchy Fishing Competition has been held in October for over 30 years and typically attracts well over 100 participants. Competitions have also been held on Lake Hawea for over 20 years and are similarly popular with 100-200 participants attending two competition weekends in November and February.

26 Harvesting fish for the table is an important motivator for some anglers. The importance of good water quality with respect to harvest is recognised in the Water Conservation (Kawarau) Order (WCO) 1997, which for Lake Wakatipu states that water quality be managed to standards including Class F (for fisheries purposes) and specifically '*fish shall not be rendered unsuitable for human consumption by the presence of contaminants*'[13].

27 A series of four National Angling Surveys have been undertaken since 1994 and provide a robust source of quantitative data on New Zealand angling[14]. The results for the relevant fisheries are shown in Table 1. For consistency water bodies are listed by 'Group' as described in the application AEE (based on waterbody type/size)[15].

28 Of the named waterbodies in application four are recognised as nationally significant, two regionally significant and four as locally significant recreational fisheries[16].

29 The three large lakes while nationally significant fisheries in their own right, also have separately recognised nationally and regionally important backcountry fisheries in their tributaries – Greenstone River, Caples River, Von River, Lochy River, Route Burn, Diamond Creek, Diamond Lake, Reid Lake (Wakatipu), Wilkin River and Young River (Wanaka), Hunter River, Dingle Burn (Hawea)[17].

30 While angling activity may not occur (or hasn't been recorded) on smaller tributary streams these provide spawning habitat and recruitment to trout

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[13] Water quality classes and standards as listed in Schedule 3 of the Resource Management Act 1991

[14] Unwin, M. (2016). Angler usage of New Zealand lake and river fisheries: results of the 2014/15 National Angling Survey. NIWA Client Report CHC2016-021 prepared for Fish & Game New Zealand.

[15] Olsen (2019). Queenstown Lakes District Wastewater Overflow Discharge Network Consent: Assessment of Ecological Effects. Prepared for Queenstown Lakes District (Appendix C to the AEE)

[16] Otago Fish & Game Council (2015). Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p.
Otago Fish & Game Council (2015). Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p.; Water Conservation Order (Kawarau) 1997,

[17] Otago Fish & Game Council (2015). Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p; Water Conservation Order (Kawarau) 1997.

populations in larger water bodies downstream. Therefore, they are integral components of the recreational fisheries they support.

31 The fisheries named in the application support a significant proportion of total recreational fishing undertaken in Otago. Over the 20-year period covered by the NAS these fisheries have collectively contributed an average of 45 % of the annual angling activity in the Otago Region (Table 1).

Table 1: Annual angler days (±1 standard error) and significance for waterbodies named in the QLDC resource consent application - RM19.051

Group	Water body	Significance	Annual angler days (±1SE)			
			2014-15	2007-08	2001-02	1994-95
Very large rivers	upper Clutha / Mata-Au	National	6,670 ±1,330	20,900 ±3,220	20,160 ±2,760	11,440 ±2,130
	Kawarau	Local	1,630 ±600	1,930 ±750	1,700 ±770	3,500 ±1,000
Medium-large rivers	Hawea	Regional	480 ±170	710 ±310	4,970 ±1,310	1,920 ±470
	Shotover	Local	150 ±80	70 ±50	1,120 ±500	130 ±60
Small-medium rivers	Arrow	Local	160 ± 100	350 ±160	-	210 ±120
	Cardrona	Local	200 ± 180	30 ±30	-	30 ±30
Large lakes	Hawea	National	13,640 ±2,490	21,920 ±2,750	28,160± 3,670	18,820± 2,260
	Wakatipu	National	21,860 ±3,170	20,970 ±2,230	17,720 ±1,910	21,410 ±2,180
	Wanaka	National	22,410 ±3,180	39,070 ±5,710	25,270 ±2,310	25,530 ±2,370
Medium lakes	Hayes	Regional	180 ±90	500 ±160	1,540 ±830	1,430 ±480
Total			67,380	106,450	100,640	84,420
Percentage of all angler days in Otago Fish and Game Region			37 %	49 %	46 %	46 %

32 Recreational angling is also commercially significant and is an important component of the Otago tourism sector. Approximately 10 % of Otago total angling activity and 50 % of the region's backcountry angling activity can be attributed to non-resident tourist anglers[18]. The Queenstown area is regarded internationally for its trout-fishing. Water clarity and opportunities for sight-fishing as well as the 'pristine' and highly scenic environment are central to the area's reputation of an angling destination[19].

33 Non-resident tourist anglers often travel specifically to fish and are high value visitors, spending considerably more than the average visitor per trip[20]. Fish and Game records identify about 40 commercial fishing guides based within the Queenstown Lake District, and a number from outside the district are known to operate in the area. Surveys have found that over 90 % of guided fishing effort can be attributed to non-resident anglers[21]. In addition, there are several charter boat operations offering fishing excursions on Lake Wakatipu (2), Lake Wanaka (2) and Lake Hawea (1).

34 Studies of angler motivations and drivers of experience satisfaction have consistently identified factors other than fish size or catch rate as being highly important to anglers[22]. For example, closeness to home, ease of access to the water body, scenic beauty and wilderness feeling have been rated as key drivers determining where anglers choose to fish. Anglers often rate these factors as being more important than the catching of a fish in determining the 'success' of their fishing experience, their overall satisfaction with their experience and their continued motivation to participate[23].

Effects of the wastewater discharges

Aquatic ecology and sports fish

35 The assessment of ecological effects (AEE) included in the QLDC consent application[24], in my view provides a thorough summary of the general risks

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[18] Unwin, M. (2016). Angler usage of New Zealand lake and river fisheries: results of the 2014/15 National Angling Survey. NIWA Client Report CHC2016-021 prepared for Fish & Game New Zealand.; Trotter, H. Backcountry Report.

[19] Hayes, S., & Lovelock, B.A. (2016). Analysis of the recreational freshwater angling behaviours of overseas visitors to New Zealand. Dunedin, New Zealand. Department of Tourism, University of Otago.

[20] Hayes, S., & Lovelock, B.A. (2016). Analysis of the recreational freshwater angling behaviours of overseas visitors to New Zealand. Dunedin, New Zealand. Department of Tourism, University of Otago.

[21] Trotter, H. (2017) Otago backcountry fisheries survey 2016-17 season. Report prepared for the November 2017 meeting of the Otago Fish and Game Council.

[22] Unwin, MJ. (2013) Values of New Zealand angling rivers: results of the 2013 National Angling Survey. Client Report CHC2013-120. 85 p.

[23] Unwin, MJ. (2013) Values of New Zealand angling rivers: results of the 2013 National Angling Survey. Client Report CHC2013-120. 85 p.; Hayes, S., & Lovelock, B.A. (2016). Analysis of the recreational freshwater angling behaviours of overseas visitors to New Zealand. Dunedin, New Zealand. Department of Tourism, University of Otago; Fish and Game Council unpublished data.

[24] Olsen (2019). Queenstown Lakes District Wastewater Overflow Discharge Network Consent: Assessment of Ecological Effects. Prepared for Queenstown Lakes District (Appendix C to the AEE)

associated with wastewater overflows entering surface waters. However, without adequate information on frequency, duration, volume, timing (seasonally) and location of the discharges the actual and potential effects of the wastewater overflows on receiving waterbodies cannot be determined.

36 The potential for significant adverse effects is acknowledged in the AEE. For example, it is noted that inputs of significant concentrations of ammoniacal nitrogen from wastewater overflows have potential the impact to ecosystem values in the receiving bodies. Otago Regional Council sampling following the detection of discharges has found very high ammonia concentrations at well above toxicity thresholds. A discharge to the Kawarau River detected on 20 February 2017 (and estimated to have occurred for a period of about two days) resulted in ammoniacal nitrogen levels of 39 mg/L[25]. A discharge to Lake Wakatipu on 31 August 2017 found at the point of discharge ammoniacal nitrogen was 48.9 mg/L (44 times the recommended guidelines level)[26]. The duration of the overflow was not reported.

37 Based on the assumption that overflow discharges are infrequent and short-term, it has been concluded in the application that the potential for acute toxic effects will be limited. However, there is no accurate data on the actual duration of past discharges (only the time between notification and the discharge ceasing)[27] or ability to accurately determine the duration of future discharges, so there is uncertainty about how valid this conclusion is.

38 Furthermore, discharge effects may be determined by the frequency as well as duration of exposure and may involve adverse sub-lethal effects (as opposed to acute toxicity effects). For example, the influence on the toxicity of ammonia to fish is impacted by both duration and frequency of exposure and may also result in adverse sub-lethal effects. Results from repeated exposure experiments on brown and rainbow trout show that although fish may be able to withstand and recover from short-term peaks in ammonia concentration, repeated exposures had a significant adverse effect on growth[28].

39 The demonstrated influence of exposure frequency indicates the need to consider the return period of transient pollution events because the return period will fundamentally influence the degree of recovery following exposure and, consequently, the long-term effects for fish populations.

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[25] ORC v QLDC [2017] NZDC 28767: Notes of Judge B P Dwyer on Sentencing; Ozanne, R. 2017. File Note Re: QLDC – discharge to Kawarau River. Otago Regional Council, Dunedin New Zealand.
[26] Ozanne, R. (2017) File Note Re: IN17.0328 – QLDC Loop Road Discharge. Otago Regional Council, Dunedin New Zealand; Augspurger, J. 2017..
[27] Based on QLDC record of overflow discharges to surfaces waters for the period 21/07/2015-28/11/2018, summarized in the evidence of Dr Greer.
[28] Milne, I., Seager, J., Mallett, M., & Sims, I. (2000). Effects of short term pulsed ammonia exposure on fish. Environmental Toxicology and Chemistry: An International Journal, 19(12), 2929-2936.

40 There is uncertainty about the frequency of discharges which will occur under the consent. The application and evidence for the applicant refers to 'occasional', 'infrequent' and 'isolated' occurrences. These descriptions do not provide an objective measure on which to base the assessments of effect. The consent places no limit on the frequency of discharges, however only the risks of infrequent discharges have been assessed.

41 The credibility of data to support the assumption of infrequent discharges has also been questioned as a result of the omission of documented overflows in the record of overflow discharges provided by QLDC[29].

42 The timing of the discharge is also important in determining actual and potential effects. For example, a discharge to a small stream during the spawning season could result in sedimentation smothering redds and acute toxicity effects[30], and result in significant adverse effects on trout spawning. Whereas the same discharge outside of spawning period might have a lesser impact.

43 Table 7 of the AEE identifies a moderate-high risk of adverse effects as a result of sedimentation and depleted oxygen levels as a result of overflow discharges to 'Streams'. This group of waterbodies are critical for spawning and are therefore particularly vulnerable to these effects.

44 Significant adverse effects could also result from cumulative effects if successive discharges were to occur to a particular receiving waterbody, or to waterbodies already affected by other activities. For example, a discharge to a stream where flows are significantly lowered due to water abstraction could increase the potential effects due to reduced dilution capacity.

45 Cumulative, chronic and sub-lethal effects (including effects for reproduction, response to stimulus, growth and development and energy use) are often difficult to detect and measure in receiving environments. These types of effects are unlikely to be detected in typical ecological assessments (such as outlined in proposed Condition 9 described in the evidence of Dr Olsen).

46 Particularly relevant to the discharge of wastewater, are the effects of complex and changing mixtures of a large number of micropollutants which include endocrine disruptors (e.g. hormones), pharmaceuticals and personal care products, caffeine and illicit drugs, as well as microplastics (in form of microfibres)[31]. Micropollutants are not routinely monitored in wastewater

[29] Paragraph 4.7 evidence of Dr Greer
[30] Salmonid eggs and new hatched juveniles (alevins) are also sensitive to nitrogen in both the form of nitrate and ammonia
[31] Temblay, LA, Northcott, GE 2015. Risk assessment of emerging contaminants in treated wastewater in the Auckland region. Prepared for Watercare Services Limited. Cawthron Report No. 2667, 45 p.; https://www.odt.co.nz/news/dunedin/otago-rates-high-mdma-use

discharges so the potential effects are poorly characterised[32]. It should be noted the effects of many of these micropollutants on aquatic life at environmentally relevant concentrations are generally not well understood, although there is evidence for sub-lethal effects for aquatic life demonstrated at trace concentrations[33].

Recreational angling values

47 In addition to direct effects on aquatic ecosystems and the sports fish populations they support, recreational angling values may also be adversely impacted by the discharge of wastewater overflows as a result of effects on amenity values and effects on the safety of waterbodies for contact recreation.

48 Effects on water clarity, the presence of scum and foams, and foul odours, may significantly detract from the pleasantness of the environment. Due to the importance of the physical setting and experiential factors in determining overall enjoyment and satisfaction for recreational anglers such effects may have significant adverse effects on the suitability and value of a site for recreational fishing.

49 The QLDC application concludes that based on infrequent and short-term wastewater discharges, and with the implementation of proposed physical response protocols, adverse effects for amenity values are considered to be transient and no more than minor[34]. However, without adequate information on duration, frequency, volume and timing of the discharge the actual and potential effects and adequacy of the proposed remediation measures cannot be determined.

50 The assessment of public health risk indicates that there is potential for significant health risk arising from the discharge of untreated sewage[35]. Health risks were determined for primary contact recreation near the discharge (activities such as swimming where full immersion and ingestion of contaminated water is likely), however it is noted that this does not imply that exposure through other forms of recreation does not create risk[36].

51 Anglers may ingest water through putting wet hands to their mouth, splashing water, holding fishing equipment in their mouth (i.e. line or flies), or if they fall in

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[32] Temblay, LA, Northcott, GE 2015. Risk assessment of emerging contaminants in treated wastewater in the Auckland region. Prepared for Watercare Services Limited. Cawthron Report No. 2667, 45 p

[33] .Schwarzenbach RP et al (2006) The challenge of micropollutants in aquatic systems. Science 313:1072–

[34] Beca Limited (2019) Queenstown Lakes District Wastewater Overflow Discharge Network Consent. Prepared for Queenstown Lakes District Council.

[35]Hudson, N. (2019). Queenstown Lakes District Wastewater Overflow Discharge Network Consent:. Prepared for Queenstown Lakes District (Appendix D to the AEE)

[36] Hudson, N. (2019). Queenstown Lakes District Wastewater Overflow Discharge Network Consent:. Prepared for Queenstown Lakes District (Appendix D to the AEE)

the water, although ingestion rates would be expected to be much lower and of shorter duration compared to swimming. Anglers however may enjoy both swimming and fishing as part of the day's activities, particularly on the lakes.

52 Based on the assumption that the discharge occurs very infrequently it is concluded in the application that the risk posed to human health is low to very low. However, given the available data assumptions about the frequency of overflows entering surface water cannot be confirmed.

53 Effects of proposed activity on recreational anglers' (or other recreational users) perceptions about the quality and 'pristineness' of the environment or perceptions about safety for recreation including recreational harvest have not been considered.

54 A consent which effectively permits discharges unlimited in number, volume, and frequency, in my opinion would be detrimental to anglers' perceptions of the pristineness of the environment, and safety of the receiving waterbodies for contact recreation and harvesting fish, which are inherently linked to the recreational fishery values present and the reputation of the area as a world-class fishing destination.

55 Satisfaction levels and motivation to continue fishing can be adversely affected by perceived deterioration of fishery resources and water quality. Such effects may arise even before significant adverse on aquatic life and sport fish populations has occurred, at a scale beyond that expected based on the actual effect, or without demonstrated evidence of an effect.

56 For example, angler surveys on Otago backcountry rivers have identified perceived water quality degradation may negatively impact on angler satisfaction and deter participation at some locations[37], even without evidence for significant ecological effects.

57 Analysis of annual usage trends by REC source-of-flow class shows that while there has been little or no long-term change in total national fishing activity rates, the trend for lowland rivers suggests a strong and persistent decline, with a 52 % decline in usage of lowland fisheries between 1994-95 and 2014-15[38]. These results are consistent with lowland water quality degradation confirmed by national scale analyses of water quality state and trends[39]. However, in my

[37] Otago Fish and Game Council unpublished data
[38] Unwin, M. (2016). Angler usage of New Zealand lake and river fisheries: results of the 2014/15 National Angling Survey. NIWA Client Report CHC2016-021 prepared for Fish & Game New Zealand.
[39] Unwin, M. (2016). Angler usage of New Zealand lake and river fisheries: results of the 2014/15 National Angling Survey. NIWA Client Report CHC2016-021 prepared for Fish & Game New Zealand; Larned, S.T. Snelder, T. Unwin, M.J. McBride, GB (2016) Water quality in New Zealand rivers: current state and trends. *New Zealand Journal of Marine and Freshwater Research.* 50.

opinion, such a significant reduction in participation reflects not only ecological effects but also the effects of widespread concerns among anglers about potential health risks of fishing and recreational harvest in urban and rural lowland streams, and perceptions about fishery quality and pleasantness of these environments.

Conclusion

58 The Queenstown Lake District area contains outstanding and internationally regarded sports fish values, with several recreational fisheries recognised as nationally and regionally important.

59 The recreational fishery values which exist rely both on the health of the aquatic ecosystem and sports fish populations, and the quality and perceptions about the physical setting and environment in which they occur.

60 Wastewater discharges can potentially cause significant adverse effects on aquatic ecology including sports fish.

61 Wastewater discharges have the potential to result in significant adverse effects on the recreational angling values present in the QLD.

62 Without adequate information on the frequency, duration, volume, timing and frequency of the discharge the actual and potential effects cannot be reliably determined.

63 Potential for significant adverse effects, including cumulative effects as a result of the discharge cannot be discounted.

Helen Diane Trotter

29 October 2019